

B7



Europäisches Patentamt
European Patent Office
Office européen des brevets



Publication number: **0 599 356 B1**

(12)

EUROPEAN PATENT SPECIFICATION

(45) Date of publication of patent specification: **20.12.95** (51) Int. Cl.⁶: **C09K 3/10, B65D 3/00, B21D 51/46**

(21) Application number: **93120774.0**

(22) Date of filing: **05.06.91**

(80) Publication number of the earlier application in accordance with Art.76 EPC: **0 478 110**

The file contains technical information submitted after the application was filed and not included in this specification

(54) Containers and compositions for sealing them

(30) Priority: **28.09.90 GB 9021167**
30.11.90 GB 9026053
18.01.91 GB 9101100

(43) Date of publication of application:
01.06.94 Bulletin 94/22

(45) Publication of the grant of the patent:
20.12.95 Bulletin 95/51

(84) Designated Contracting States:
AT BE CH DE DK ES FR GB GR IT LI LU NL SE

(56) References cited:
EP-A- 0 129 309 EP-A- 0 174 032
EP-A- 0 349 305 GB-A- 2 108 943
US-A- 3 779 965 US-A- 4 833 206

DATABASE WPI Derwent Publications Ltd.,
London, GB; AN 73-26927U & JP-A-48 014 708

(73) Proprietor: **W.R. Grace & Co.-Conn.**
Grace Plaza,
1114 Avenue of the Americas
New York,
New York 10036 (US)

(72) Inventor: **White, Steven Andrew Carl**
1 Fox Grove,
Godmanchester
Huntingdon,
Cambridgeshire PE18 8BN (GB)

(74) Representative: **Jones, Helen Marjorie Mer-**
edith
Gill Jennings & Every,
Broadgate House,
7 Eldon Street
London EC2M 7LH (GB)

EP 0 599 356 B1

Note: Within nine months from the publication of the mention of the grant of the European patent, any person may give notice to the European Patent Office of opposition to the European patent granted. Notice of opposition shall be filed in a written reasoned statement. It shall not be deemed to have been filed until the opposition fee has been paid (Art. 99(1) European patent convention).

Description

This invention relates to the sealing of beer bottles, and to the compositions for use in this.

A beer bottle is filled with beer and is formed of a bottle body, a cap and a sealing gasket. The body
 5 has a neck opening, the cap fits over this opening so as to close it, and the sealing gasket is trapped between the neck opening and the cap.

The gasket must provide a good seal between the body and the cap so as to prevent inward migration of volatile odours or other contamination or unwanted outward escape of carbon dioxide. Preventing inward migration is particularly important because beer is very susceptible to the development of off-tastes and
 10 these can be caused by a variety of contaminants. For instance the inward migration of oxygen will spoil the flavour as will the inward migration of volatile odours such as chlorinated phenols and chlorinated anisoles. Chlorinated phenols are often applied initially as fungicides to wood or other containers in which the beer bottles may be stored, and chlorinated anisoles are often generated as microbial metabolites of the chlorinated phenols.

15 Unwanted outward migration of carbon dioxide is undesirable since the beer would then acquire a flat taste and texture, and so the seal must withstand moderate pressures, for instance up to about 5 and often about 7 bar without venting. It might be thought that it would be desirable for there to be no sensible upper limit on the pressure that the gasket can withstand without venting. In practice however it is desirable for the gasket to vent at a pressure below a pressure at which the bottle will burst. This is because if a beverage
 20 bottle is left in an exposed place, for instance hot sunshine, high pressures can be generated spontaneously. It is desirable that the gasket should vent in preference to the bottle shattering. In practice this means that the gasket should vent before the pressure exceeds around 12 or 13 bar.

The ideal gasket for beer bottles therefore would prevent ingress of oxygen and off flavours and would give a good seal at a moderate internal pressure, typically up to about 5 bar, but would vent at a higher
 25 pressure that is below the burst pressure of the bottle, and that is typically in the range 5 to 12 or 13 bar.

The steps of lining the gasket into the cap and of subsequently filling and closing the beer bottles are all conducted at very high speed and so it is necessary that the gasket material should be capable of being used in these high speed processes and that it should give uniform results. For instance it is not
 30 satisfactory to use a composition that gives a venting pressure of, for instance, 12 bar in some bottles if it is liable to give venting pressures as low as 9 bar or as high as 15 bar in other bottles since a significant number of the bottles would still be liable to burst and this is unacceptable.

A wide variety of processes and compositions have been proposed for forming the gasket in various container closures, for instance bottle caps. These include plastisols, solutions in organic solvents, aqueous dispersions (including aqueous latices) and mouldable thermoplastic compositions. An early disclosure of
 35 the use of thermoplastic compositions for forming container closures is in GB-A-1112023, GB-A-1112024 and GB-A-1112025. Beer bottles are not mentioned. GB-A-1112023, GB-A-1112024 and GB-A-1112025 describe a wide variety of ways of introducing the compositions into the cap and a wide variety of thermoplastic compositions that can be used.

The closures in GB-A-1,112,023 were according to Example 1, tested for sealing properties at 3 volume
 40 and 5 volume carbonation with storage for 38 °C at 1 month. These tests are conducted at, respectively, 4.3 bar and 7.9 bar and so merely showed that these closures maintained an internal pressure of up to 7.9 bar for one month.

Methods that are described in these three patents include inserting and bonding a preformed uniform disc into the cap, inserting and bonding a preformed contoured disc into the cap, flowing a composition into
 45 the cap while rotating it and optionally moulding it, flowing a composition into the cap and moulding it while the composition is still hot, inserting a disc of composition carried on a metal plate, transferring composition by a moulding die and moulding it into the cap, compression moulding the composition into the cap, and so on. In all the examples, the composition was formed into a sheet, discs were cut from it and the discs were then inserted into the caps and cold moulded into the caps. In many of the examples the inserted disc had
 50 a diameter substantially the same as the diameter of the cap.

Thermoplastic compositions that were described include blends of ethylene vinyl acetate copolymer (EVA) and micro crystalline wax, EVA and low density polyethylene (LDPE) having a melt flow index (MFI) of 7, similar blends containing also butyl rubber having Mooney viscosity of 70, a blend of equal amounts of LDPE having MFI 7 with butyl rubber having Mooney 70, blends of different types of EVA, a blend of LDPE
 55 with polyisobutylene, a blend of EVA with ethylene propylene copolymer, an ethylene acrylic acid ester copolymer, a blend of this with LDPE, a blend of LDPE with ethylene propylene copolymer, and a blend of LDPE with chloro sulphonated polyethylene.

Various disclosures of forming gaskets from thermoplastic compositions have appeared from time to time since then and these have listed a wide variety of polymers that can be used. Generally, most of the polymers named above have been listed. An example is EP-A-0331,485 in which molten material is positioned in the cap while still molten (or semi molten) and is moulded into the cap.

5 In practice, the thermoplastic compositions that have been proposed and used most widely as gaskets for containers are compositions of polyethylenes, ethylene vinyl acetate copolymers, and blends thereof. None of the others have attracted any great commercial interest, presumably because of perceived difficulties in making or using the compositions or in their performance.

As indicated, the gasket properties required for beer bottles are quite rigorous. Very good results can
10 be obtained with, for instance, a cap that is a crown closure having a gasket formed of cork lined with aluminium. However this is uneconomic for beer bottle closures and a synthetic polymeric gasket is required.

Of the very wide range of polymeric gasket materials that have been available in recent years, the type that has been used most widely for beer bottles is based on polyvinyl chloride plastisol. However it is well
15 recognised that bottled beer has a relatively short shelf life and can acquire off-tastes on prolonged storage and so a polymeric gasket that permitted a longer shelf life would be highly desirable. Also, the use of polyvinyl chloride in contact with potable or edible materials has in recent years been considered to be undesirable for other reasons and so again it would be desirable to provide beer bottles with an improved type of gasket material.

20 PVC-free sealing compositions for bottle gaskets were described by DS-Chemie in EP-A-0250057.

In Die Brauwelt, 3, 1991, pages 47 and 48 it is stated "PVC compounds for crown closures are under attack, not only because of their PVC content, but also because of the plasticisers, which are the other main component of the (compound) formula. According to a communication from DS-Chemie, Bremen, PVC-free technology, amongst other, is based on the following raw materials: polyethylene, polypropylene, EVA,
25 various rubber types such as SBS, SIS, butyl-rubber. Depending on the combination of these various raw materials the properties, essential for the beverage industries, can be obtained".

This article mentioned certain effects such as reduced pressure-holding, oxygen barrier, and chloroanisole barrier effects. No actual compositions are described in the article (which was published after the priority date of this application). The polymers listed in this article are typical of those previously listed
30 for possible use in PVC-free closures and so this article merely outlines the problems and does not offer any solution to these problems.

JP-A-48-014708 describes gasketed caps for bottles for beer and other drinks, in which cork gaskets of the prior art are replaced by a synthetic polymer material. The content of butyl rubber in the compositions are never higher than 8.5% by weight of the total composition.

35 In US-A-4,833,206 rubber compositions are used as closures for food or pharmaceutical vessels. The compositions are vulcanised and are thus not thermoplastic. The examples all contain more than 67% by weight of rubber, the rubber generally being a butyl rubber.

According to the invention, a beer bottle filled with beer is formed of a body, a cap and a sealing gasket that is between the body and the cap and that is formed of a polymeric material, and the polymeric material
40 is a thermoplastic composition that is a homogeneous blend of 20 to 60% by weight of butyl rubber and 40 to 80% by weight other thermoplastic polymer.

The invention also includes the use of this thermoplastic composition for forming a gasket in a cap of a bottle that is to be filled with beer, and it includes caps of beer bottles wherein the caps contain a gasket formed of the composition.

45 A particularly important aspect of the invention consists in the bottle being in a package including volatile odour, since the defined gasket can provide very effective barrier properties to volatile odours, especially chlorinated phenol and chlorinated anisole. Naturally, the body and cap should also be impermeable to the odour.

The invention also includes the use of the defined gasket to provide a seal that withstands moderate
50 internal pressures (e.g., of up to 5 bar or even 7 bar) but that vents at internal pressures of between 5 and 12 bar, often 7 to 12 bar.

The invention also includes a method in which the gasket is formed by placing a molten piece of the thermoplastic composition in the bottle cap and then moulding the composition in the cap to form the desired gasket.

55 We surprisingly find that it is possible to formulate gaskets as defined in the invention that give excellent sealing properties for beer in that they are convenient to form and provide excellent resistance to the ingress of contamination that would give off-tastes. In particular, they give excellent protection both against ingress of oxygen and against ingress of volatile odours such as chlorinated phenol or chlorinated

anisole.

Also it is possible to formulate such gaskets that will provide a seal at moderate internal pressures, for instance of up to around 5 bar, but that will then vent at slightly higher pressures, for instance between 5 and 12 or 13 bar.

5 In addition to giving good impermeability against ingress of oxygen and volatile odours (especially chloro anisole), and in addition to giving a satisfactory venting pressure, a further advantage of the compositions according to the invention is that the properties are relatively uniform from one gasket to another. In particular, it is possible to avoid wide variations in the venting pressure.

Since the gasket is not based on polyvinyl chloride, it avoids the disadvantages that are now considered
10 to be associated with polyvinyl chloride gaskets, and additionally it provides better impermeability to oxygen and chlorinated phenols and chlorinated anisoles than the PVC gaskets that have been customarily used in recent years for beer bottle gaskets. The gaskets used in the invention give much better properties in these respects than the thermoplastic gaskets, such as the polyethylene and/or ethylene vinyl acetate gaskets, that have actually been used for proposed for use in various other container closures in recent
15 years.

The body of the beer bottle used in the invention can be any conventional beer bottle body. It is usually made of glass. However it can be of polymeric material provided the material of which the body is formed (including any coating on the polymeric material) is such that the body is substantially impermeable to oxygen and chlorinated phenols and chlorinated anisoles. Thus, the permeability of the body must be
20 sufficiently low that it will not permit leakage of oxygen or other contaminants into the bottle to an extent that significantly reduces the advantages of the impermeable gasket of the invention.

The cap is preferably a crown closure but can be a roll-on or screw-on closure. It is preferably metal but can be plastic, again provided the plastic (including any coating on it) is sufficiently impermeable. The closure may include a tamper-evident or pilfer-proof feature of any suitable design.

25 The invention is of particular value where the bottle is of glass and the cap is of metal, especially when the bottle is to be pasteurised after it has been filled with beer and sealed.

Although the invention includes individual bottles and packages in environments that are free of volatile odours, the invention also includes any package that includes a volatile source of an off-taste.

This volatile source of off-taste is preferably a volatile odour that, when absorbed into the potable
30 material, will carry an off-taste into that material. The volatile source of off-taste can be a material that has been deliberately applied to the package or a component in the package (for instance a wood preservative) or can be a material that has been accidentally applied as a result of, for instance, previous use of the package for transporting a different product.

Accordingly the volatile source of off-taste can be substantially any volatile material that could be
35 present in a truck, container or other package due to a previous shipment. Examples are paint solvents and thinners such as ketones, esters, aromatic solvents and white spirit, and volatile insecticides or other pesticides such as dichlorobenzene or chlorinated phenols, amongst a wide range of other volatile odours that will impart an off-taste.

The invention is, however, of particular value when the volatile odour that will impart an off-taste is a
40 chlorinated phenol or chlorinated anisole, and so preferably the package includes a source of chlorinated phenol or chlorinated anisole, and in particular a source that will provide an environment that provides a concentration of trichloro anisole around the bottle of at least 1×10^{-9} g/l. For instance the package could be of jute but normally includes wood that may have been accidentally contaminated with a chlorinated material previously or, more usually, has been deliberately impregnated with chlorinated phenol to act as a
45 wood preservative and which is therefore contaminated with chlorinated anisole.

The package can be a pallet on which a plurality of bottles are carried, for instance shrink wrapped on to the pallet. Alternatively or additionally the package can be a wooden crate containing the bottles. Alternatively the package can be a transport container that contains the bottles and wood containing chlorinated phenol or anisole, for instance crates or pallets loaded with the bottles.

50 The amount of butyl rubber is at least about 20% and is generally at least about 30% but is usually not more than about 50% or 55% by weight of the blend. Preferably it is about 35 or 40 to 50% with about 45% often being optimum. The butyl rubber is a copolymer of isoprene and butylene. The molecular weight can be relatively low or relatively high. Generally it is linear, but it can be cross-linked. Generally the rubber has Mooney (ML1 + 8 at 125 °C) of below 60 and preferably below 56.

55 When it is particularly important that the gasket should vent at a pressure in the range 5 to 12 bar, the use of butyl rubbers having relatively low molecular weight can be preferred, for instance the rubber can have a defined Mooney value (ML1 + 8 at 110 °C) of below 50, generally below 47, most preferably in the range 43 to 47. However a satisfactory combination of impermeability and venting pressure can be

achieved at higher Mooney values.

The one or more other thermoplastic polymers in the blend must be selected such that they can be blended with the butyl rubber to form a substantially homogeneous melt which can be extruded and moulded into the cap in a convenient manner to form an adherent gasket having the desired properties. The thermoplastic polymers conventionally mentioned in the literature for thermoplastic gaskets can be used for this purpose and, provided they are blended with butyl rubber in the desired proportions, it is relatively easy to select blends that give the surprising combination of good sealing properties and impermeability to chlorinated phenols and chlorinated anisoles and other volatile odours.

Preferred thermoplastic materials are polyethylene or ethylene copolymers with butylene or other lower alkylenes (such as octene), polypropylene, thermoplastic rubbers, ethylene propylene copolymers, acid modified ethylene propylene copolymers, polybutadienes, styrene butadiene rubber, carboxylated styrene butadiene, polyisoprene, styrene isoprene styrene block copolymers, styrene butadiene styrene block copolymers, styrene ethylene butylene styrene block copolymers, polystyrene, ethylene vinyl acetate copolymers, ethylene (meth) acrylate copolymers and ethylene vinyl alcohol copolymers.

Particularly preferred materials comprise polyethylenes. In some instances, it is preferred to use low density polyethylene but in general high density is more suitable, especially when the main requirement is impermeability against the ingress of contamination. The melt flow index is typically in the range 5 to 30 but higher or lower values can be useable.

Blends of butyl with a mixture of 1 part styrene butadiene styrene block copolymer with 3 to 8 parts, often around 5 or 6 parts, polyethylene, generally LDPE, can give particularly good results, especially when the LDPE is a relatively low MFI polymer, typically in the range MFI 5 to 10.

Good results can also be obtained with ethylene propylene rubbers, especially when blended with a mineral oil, generally in the ratio of 1 part oil to 1.5 to 4, often around 2 to 3, parts by weight ethylene propylene rubber.

Blends of polyethylene (usually low density polyethylene), ethylene vinyl acetate and the butyl rubber can be used but it is generally preferred to form the composition substantially only of polyethylene and butyl rubber.

The gasket can be formed from the thermoplastic composition by placing the polymeric material in the cap and moulding it to form the gasket by various techniques. The presence of the butyl rubber in the thermoplastic composition can make it rather difficult to handle, and this has probably been a disincentive from using butyl rubber previously. The preferred method comprises placing a molten piece of the thermoplastic composition in the cap and then moulding the molten composition. At the time of placement and moulding the composition may be truly molten or may merely be soft.

It is preferred to form a molten mix of the butyl rubber and the thermoplastic polymer or polymers, for instance by melting a preformed mix in a melt extruder and to extrude the mix continuously and to transfer the desired pieces of molten mix direct from the point of extrusion to the individual caps. Processes of this general type are known as the HC (trade mark) cap process, the Sacmi (trade mark) and the Zapata (trade mark) processes. Such processes are described in, for instance, U.S.-A-4,277,431, EP-A-0073334, U.S.-A-3,705,122 and US-A-4,518,336, and EP 207,385. It is particularly preferred to conduct the process as described in EP-A-0331485.

The dimensions of each cap will be selected according to the dimensions of the bottle and these dimensions, and the amount of thermoplastic composition deposited in each cap, will be conventional.

The following are examples of the invention.

Example 1

50 parts by weight high density polyethylene having a density of 0.950 and a melt flow index of 11dg/min is blended with 50 parts of a low molecular weight isoprene butylene copolymer. The melt is extruded and appropriately sized pieces of the melt are transferred while soft into beer bottle crown caps, where each is moulded into a gasket in a conventional manner. These operations are conducted on a conventional lining machine.

Beer bottles are filled with beer and then closed with the lined caps in conventional manner. They have long shelf storage life.

In order to test the properties of various thermoplastic compositions, a number of laboratory tests were conducted that simulate the conditions to which gaskets would be exposed during use as gaskets in beer bottles. In each of these, blends of the thermoplastic compositions set out below are formed as pellets and then melted in a melt extruder, extruded and inserted into a plurality of bottle crown caps and moulded into annular gaskets, using a commercial lining machine.

EP 0 599 356 B1

The polymeric materials that were used are described by the following abbreviations.

- PE1 : Low density polyethylene MFI:7, Density: 0.918
- PE2 : Low density polyethylene MFI:20, Density: 0.918
- PE3 : High density polyethylene MFI:11, Density: 0.950
- 5 BU1 : Low molecular weight isoprene/butylene copolymer
- BU2 : High molecular weight isoprene/butylene copolymer Mooney viscosity (ML1 + 8 at 125°C) : 46-56
- BU3 : Cross-linked isoprene/butylene copolymer
- EVA1 : Ethylene vinyl acetate copolymer 9% vinyl acetate, MFI:9dg/min
- 10 EVA2 : Ethylene vinyl acetate copolymer 18% vinyl acetate, MFI:9dg/min
- EVA3 : Ethylene vinyl acetate copolymer 28% vinyl acetate, MFI:7dg/min
- SBS : Styrene butadiene styrene block copolymer
- EPM : Ethylene propylene rubber
- Oil : Mineral oil
- 15 PVC : Polyvinyl chloride plastisol commercial composition

Example 2

To determine oxygen ingress, the lined caps had a 200mg film weight and were sealed on to a 30cl
 20 returnable glass bottle filled with carbonated water having very low (5mg/l) initial oxygen content. The sealed bottles are stored under ambient conditions and are tested for oxygen content at different time intervals as shown in Tables 1 and 2 below.

Table 1

25

Composition	1	2	3	4	5	6	7	8	9
LDPE 1	50						85	60	
LDPE 2		50		50		60			
30 HDPE			50		50				
Butyl 1	50	50	50		20				
Butyl 2				50					
Butyl 3					30	40			
35 SBS							15		
EVA								40	
PVC									100

Table 2

40

Composition	2 weeks	1 month	2 months	3 months	4 months	6 months
1	9	22	48	72	106	157
2	13	29	49	76	110	152
45 3	15	20	37	38	59	112
4	22	25	49	53	85	161
5	47	73	95	67	68	166
6	63	38	67	63	88	176
7	-	153	285	-	-	-
50 8	27	80	188	282	327	-
9	90	179	401	590	774	1114

This shows that the six compositions containing butyl rubber provide a much better barrier against
 55 ingress of oxygen than the other thermoplastic compositions that are tested, and, especially, much better than the commercial PVC compositions. It also shows that the best results in this test are obtained using a blend of high density polyethylene with low molecular weight butyl rubber (composition 3).

Example 3

In this test, the resistance of the gasket against ingress of trichloro anisole (TCA) is determined.

The lined crowns are closed on to glass bottles containing carbonated water having a carbonation level of 2.7 volumes and treated with 5% by volume ethanol in order to simulate beer. The bottles are then stored for 14 days at 30 °C in an atmosphere containing 200 µg/l 2,4,6-trichloroanisole (TCA). The bottles are then analysed for TCA content.

As a comparison, it should be noted that when a foamed plasticised PVC gasket is subjected to the same test, the measured TCA content at the end of the storage period is 123 ng/l.

The results are set out in Table 3.

Table 3

	A	B	C	D	E	F
PE1	50	-	-	-	-	-
PE2	-	50	-	50	50	50
PE3	-	-	50	-	-	-
BU1	50	50	50	-	20	-
BU2	-	-	-	50	-	-
BU3	-	-	-	-	30	40
TCA Content (ng/l)	<1	<1	<1	<1	<1	12
	G	H	I	J	K	L
PE1	100	-	50	-	-	-
PE2	-	-	-	40	50	60
EVA1	-	100	50	-	-	-
EVA2	-	-	-	20	-	-
BU1	-	-	-	40	50	40
TCA Content (ng/l)	1005	1160	370	<2	<2	<2

It will be observed from these results that the gaskets formed from the materials usually used for thermoplastic container sealing compositions (G, H and I) all give poor results that are significantly worse than the polyvinyl chloride composition mentioned above. All the compositions illustrated in the table and that contained a butyl rubber give very much better results. Composition F, containing cross linked butyl rubber, is not as good as the others and this may be due to difficulties in obtaining a substantially homogeneous blend, due to the cross linking.

Example 4

In this test, the venting pressure of the compositions is determined. The lined crowns were closed on to glass bottles containing carbonated water having a carbonation level of 2.7 volumes giving a pressure of 2.2 bar at room temperature.

After a storage time of 24 hours at room temperature, the venting pressures were measured using an Owens-Illinois Secure Seal tester and the venting pressure for a range of crown closures was observed and the maximum, minimum and mean values were recorded. The results are as follows in which polymer proportions are in parts by weight and pressures (mean, maximum and minimum) are in bars.

Table 4

LDPE 1	100	90	80	-	70	-	50	-
HDPE	-	-	-	80	-	70	-	50
Butyl 1	-	10	20	20	30	30	50	50
Mean	13+	12.9	10.7	12.8	11.1	10.7	9.8	8.9
Max	13+	13+	13+	13+	13+	13+	11.5	9.5
Min	13+	11.5	8.5	12.0	8.5	9.5	7.5	7.0

EP 0 599 356 B1

These results indicate that in these particular tests the maximum venting pressure is below 13 bar when butyl is above 30%. At this level HDPE is better than LDPE.

Table 5

LDPE 1	50	-
LDPE 2	-	50
Butyl 1	50	50
Mean	10.8	9.7
Max	12.5	11.5
Min	9.0	7.0

These results indicate that the lower molecular weight LDPE (higher MFI) is better.

Table 6

LDPE 2	50	50
Butyl 1	50	-
Butyl 2	-	50
Mean	9.7	10.9
Max	11.5	13 +
Min	7.0	9.0

These results indicate that the lower molecular weight butyl give the better performance.

Table 7

LDPE 1	85	42.5
SBS	15	7.5
Butyl 1	-	50
Mean	12.8	8.3
Max	13.0	10.5
Min	12.0	7.0

Table 8

EPM	70	35
Oil	30	15
Butyl 1	-	50
Mean	13 +	11.7
Max	13 +	13 +
Min	13 +	4.5

These show that the inclusion of butyl reduces the venting pressure.

Example 5

The final composition in Table 4 (50 HDPE, 50 Butyl 1) is used for lining 30 bottles of the size and with the filling shown in Example 4 on a commercial bottling machine. The mean, maximum and minimum values are 6.75, 8.05 and 5.60 bars.

Example 6

The following compounds were moulded into crowns and when closed onto 330ml glass bottles containing carbonated mineral water. The bottles were then stored for 10 days at room temperature in a sealed container containing p-dichlorobenzene (DCB). The concentration of DCB in the water was then measured.

Composition	M	N	O	P
PE1				85
PE3	50			
PE4		45	45	
BU1	50	45	40	
SBS				15
SEBS		10	15	
ppm DCB	70	80	120	400
PE4 : High density polyethylene, density 0.95; MFI 25				
SBS : Styrene butadiene block copolymer 29.5% bound styrene				
SEBS : Styrene ethylene butylene styrene block copolymer 29% bound styrene				

The other components are as described above.

Again, this clearly demonstrates the surprising benefit obtained using compositions according to the invention including butyl rubber, in contrast to compositions free of butyl rubber.

Claims

1. A beer bottle cap lined with a gasket formed of a thermoplastic polymer composition characterised by comprising a homogeneous blend of 20 to 60% by weight butyl rubber, which is a copolymer of isoprene and butylene, and 40 to 80% by weight other thermoplastic polymer.
2. A beer bottle cap according to claim 1 in which the gasket has been formed by placing a molten piece of the thermoplastic composition in the bottle cap and then moulding the molten composition to form the gasket.
3. A beer bottle cap according to any preceding claim in which the amount of butyl rubber is from 30 to 50% by weight of the composition.
4. A beer bottle cap according to any preceding claim in which the butyl rubber has Mooney (ML1 +8 at 110 °C) of below 50.
5. A beer bottle cap according to any preceding claim in which the butyl rubber has Mooney (ML1 +8 at 125 °C) of below 60.
6. A beer bottle cap according to any preceding claim in which the said other thermoplastic polymer is selected from polyethylene or ethylene copolymer with other lower alkenes, polypropylene, thermoplastic rubbers, ethylene propylene copolymers, acid modified ethylene propylene copolymers, polybutadiene, styrene butadiene rubber, carboxylated styrene butadiene copolymer, polyisoprene, styrene isoprene styrene block copolymers, styrene butadiene styrene block copolymers, styrene ethylene butylene styrene block copolymers, polystyrene, ethylene vinyl acetate copolymers, ethylene (meth) acrylate copolymers and ethylene vinyl alcohol copolymers.
7. A beer bottle cap according to any preceding claim in which the said other thermoplastic polymer comprises polyethylene.
8. A beer bottle cap according to any preceding claim in which the said other thermoplastic polymer consists only of polyethylene.

9. A beer bottle cap according to claim 8 in which the polyethylene is low density polyethylene.
10. A beer bottle cap according to claim 8 or 9 in which the thermoplastic polymer consists only of 35 to 50% butyl rubber and 65 to 50% polyethylene.

5

Patentansprüche

1. Bierflaschenkappe, die mit einer aus einer thermoplastischen Polymerzusammensetzung gebildeten Dichtung ausgekleidet ist, die dadurch gekennzeichnet ist, daß sie eine homogene Mischung aus 20 bis 60 Gew.-% Butylkautschuk, der ein Copolymer aus Isopren und Butylen ist, und 40 bis 80 Gew.-%
10 anderem thermoplastischem Polymer umfaßt.
2. Bierflaschenkappe nach Anspruch 1, bei der die Dichtung gebildet worden ist, indem ein geschmolzenes Stück der thermoplastischen Zusammensetzung in die Flaschenkappe gegeben worden ist und
15 dann die geschmolzene Zusammensetzung geformt worden ist, um die Dichtung zu bilden.
3. Bierflaschenkappe nach einem der vorhergehenden Ansprüche, bei der die Menge an Butylkautschuk bezogen auf das Gewicht der Zusammensetzung 30 bis 50 % ausmacht.
- 20 4. Bierflaschenkappe nach einem der vorhergehenden Ansprüche, bei der der Butylkautschuk eine Mooney (ML1 + 8 bei 110 °C) unterhalb von 50 aufweist.
5. Bierflaschenkappe nach einem der vorhergehenden Ansprüche, bei der der Butylkautschuk eine Mooney (ML1 + 8 bei 125 °C) unterhalb von 60 aufweist.
- 25 6. Bierflaschenkappe nach einem der vorhergehenden Ansprüche, bei der das andere thermoplastische Polymer ausgewählt ist aus Polyethylen oder Ethylencopolymer mit anderen niederen Alkenen, Polypropylen, thermoplastischen Kautschuken, Ethylen/Propylen-Copolymeren, säuremodifizierten Ethylen/Propylen-Copolymeren, Polybutadien, Styrol/Butadien-Kautschuk, carboxyliertem Styrol/Butadien-Copolymer, Polyisopren, Styrol/Isopren/Styrol-Blockcopolymeren, Styrol/Butadien/Styrol-Blockcopolymeren, Styrol/Ethylen/Butylen/Styrol-Blockcopolymeren, Polystyrol, Ethylen/Vinylacetat-Copolymeren, Ethylen/(Meth)acrylat-Copolymeren und Ethylen/Vinylalkohol-Copolymeren.
- 30 7. Bierflaschenkappe nach einem der vorhergehenden Ansprüche, bei der das andere thermoplastische Polymer Polyethylen umfaßt.
- 35 8. Bierflaschenkappe nach einem der vorhergehenden Ansprüche, bei der das andere thermoplastische Polymer nur aus Polyethylen besteht.
- 40 9. Bierflaschenkappe nach Anspruch 8, bei der das Polyethylen Polyethylen niederer Dichte ist.
10. Bierflaschenkappe nach Anspruch 8 oder 9, bei der das thermoplastische Polymer nur aus 35 bis 50 % Butylkautschuk und 65 bis 50 % Polyethylen besteht.

45 Revendications

1. Capsule pour bouteille de bière enduite d'un joint formé d'une composition d'un polymère thermoplastique, caractérisée en ce qu'elle comprend un mélange homogène de 20 à 60% en poids de caoutchouc butyle, qui est un copolymère d'isoprène et de butylène et 40 à 80% en poids d'un autre polymère
50 thermoplastique.
2. Capsule pour bouteille de bière selon la revendication 1, où le joint a été formé en plaçant un morceau fondu de la composition thermoplastique dans la capsule de la bouteille puis en moulant la composition fondue pour former le joint.
- 55 3. Capsule pour bouteille de bière selon toute revendication précédente, où la quantité de caoutchouc butyle est comprise entre 30 et 50% en poids de la composition.

4. Capsule pour bouteille de bière selon toute revendication précédente, où le caoutchouc butyle a une Mooney (ML1 + 8 à 110 ° C) de moins de 50.
5. Capsule pour bouteille de bière selon toute revendications précédente, où le caoutchouc butyle a une Mooney (ML1 + 8 à 125 ° C) de moins de 60.
6. Capsule pour bouteille de bière selon toute revendication précédente, où ledit autre polymère thermoplastique est sélectionné parmi le polyéthylène ou un copolymère d'éthylène avec d'autres alcènes inférieurs, le polypropylène, des caoutchoucs thermoplastiques, des copolymères d'éthylène propylène, des copolymères d'éthylène propylène modifiés à l'acide, du polybutadiène, un caoutchouc de styrène butadiène, un copolymère de styrène butadiène carboxylé, du polyisoprène, des copolymères séquencés de styrène isoprène styrène, des copolymères séquencés de styrène butadiène styrène, des copolymères séquencés de styrène éthylène butylène, le polystyrène, des copolymères d'éthylène acétate de vinyle, des copolymères de (méth)acrylate d'éthylène et des copolymères d'éthylène alcool vinylique.
7. Capsule pour bouteille de bière selon toute revendication précédente, où ledit autre polymère thermoplastique se compose de polyéthylène.
8. Capsule pour bouteille de bière selon toute revendication précédente, où ledit autre polymère thermoplastique ne se compose que de polyéthylène.
9. Capsule pour bouteille de bière selon la revendication 8, où le polyéthylène est du polyéthylène de faible densité.
10. Capsule pour bouteille de bière selon la revendication 8 ou 9, où le polymère thermoplastique se compose seulement de 35 à 50% de caoutchouc butyle et 65 à 50% de polyéthylène.